An Intelligent Inspection and Survey Robot

Developer: **South Carolina Universities Research and Education Foundation**
Contract Number: DE-AC21-92MC29115
Crosscutting Area: N/A

Mixed Waste
FOCUS AREA

Problem:

Most Transuranic (TRU) Waste and Low-Level Waste (LLW) are stored in above-ground drums or other containers stacked in rows in warehouses at Department of Energy (DOE) facilities. EPA and DOE requirements mandate regular inspection of the storage areas and require significant manpower resources. In addition, radiation levels external to the storage containers may present a hazard in that inspection personnel could be exposed to significant radiation levels during the inspection process.

Solution:

A new accurate and consistent inspection can be performed using a mobile robot system. An enhanced commercial mobile vehicle (from Cybermotion, Inc.) is capable of meeting many of the demands of the missions of environmental compliance at DOE sites. This mobile robot, ARIES (A Robotic Inspection Experimental System), is designed to navigate rows of drums while performing automated visual inspection with cameras positioned to inspect the drums. When leaks or damage to the drums are detected, this information is maintained in a database that may be used by operators to investigate the potential problem areas.

Benefits:

▸ Conduct repetitive and autonomous inspections of stacked drums efficiently and accurately

▸ Reduced manpower needs and personnel radiation exposure

▸ Provide teleoperated assistance for manipulating instrumentation and tools required for detailed inspection of suspect drums

Technology:

Mobile robots and schemes for autonomous navigation have been under development at various universities and National Laboratories. An autonomous inspection system such as ARIES, however, has not been demonstrated.

The mobile robot system is designed with enhanced intelligence and navigation capabilities to conduct routine inspection of stored waste drums. ARIES will maneuver in aisles which are 36 inches or greater in width. The system is capable of deploying on an assigned inspection mission, collecting required survey and inspection information, generating and maintaining mission data records, and reporting the completion of the mission.

The system consists of the following major subsystems: a newly designed narrow-aisle vehicle base and application turret; an onboard ultrasonic system and lidar system for navigation and collision avoidance; radio communications systems; an autocharging station with docking instrumentation and referencing capability; work packages for the manipulations of

cameras and other instruments; and onboard and offboard computing systems for mission planning, management, and reporting.

A vision work package is comprised of a camera, illumination systems, and a deployment system along with pattern recognition software that can identify "suspect" drums. This visual inspection module is used during autonomous inspection missions that may be deployed during work shifts when personnel and other equipment would not be in the warehouse.

The acquired data is sent via the charging station, or other autodocking stations designated for that purpose, to offboard computers. A database containing information from the inspection and survey missions is available for the generations of routine reports and special reports that may be required by DOE and EPA. All such data will be added to the drum database that is maintained during the autonomous survey. Thus, inventory control is completely automated consequently minimizing manpower requirements.

ARIES is one of three drum inspection technologies to participate in a "bake-off" among similar and competing technologies. The other two technologies are the Intelligent Mobile Sensor System (IMSS, developed by Lockheed Martin) and the Automated Baseline Change Detection (ABCD) system (also developed by Lockheed Martin).

This project was completed in July 1998. At completion, the system had been tested at Fernald and Los Alamos. Additional testing related to operational issues was conducted at the International Union of Operating Engineers test facility in Beaver, WV. Based on input from the Mixed Waste Focus Area, ARIES units I and II were delivered to the Idaho National Engineering and Environmental Laboratory (INEEL) in July 1998. The units were tested to show the functionality and operability of the systems. The INEEL will further test the systems and will offer to use them at other sites in the future for drum inspection or similar applications.

Contacts:

South Carolina Universities Research and Education Foundation (SCUREF) is a consortium of southeastern universities with extensive experience in integrating robotic systems for practical applications. This project is supported by the University of South Carolina and Clemson University. Cybermotion, Inc. Salem, VA is an industrial partner in this project. For information on this project, the contractor contact is:

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DOE's Federal Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

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